

REMARKS

Claims 1-13 are pending and stand ready for further action on the merits.

Claims 1 and 9 have been amended to use proper Markush language. The above-amendment does not narrow the scope of the invention and/or has not been made for the sake of patentability. No new matter has been added by way of the above-amendment.

Issues Under 35 USC § 112, Second Paragraph

Claims 1 and 9 are rejected under 35 USC § 112, second paragraph, for being indefinite.

The Examiner objects to these claims for not containing proper Markush language.

Although Applicants firmly believe that claims 1 and 9 are sufficiently definite to satisfy the requirements of 35 USC § 112, second paragraph, Applicants have amended these claims as suggested by the Examiner in order to advance prosecution.

Based on the foregoing, Applicants respectfully request that the rejection be withdrawn.

Issues Under 35 USC § 103

The following rejections are pending:

- (A) Claims 1, 3-7 and 10-13 are rejected under 35 USC § 103(a) as being unpatentable over van der Meer et al. (US 4,888,397), Jalbert et al. (US 4,654,405) or WO 87/00540 (WO '540) in view of Furuta et al. (US 5,278,254 or US 5,498,689);
- (B) Claims 1 and 3-13 are rejected under 35 USC § 103(a) as being unpatentable over van der Meer et al., Jalbert et al. or WO '540 in view of Furuta et al., and further in view of Newman et al. (US 5,990,256); and
- (C) Claims 1-7 and 10-13 are rejected under 35 USC § 103(a) as being unpatentable over van der Meer et al., Jalbert et al. or WO '540 in view of Furuta et al., and further in view of WO 99/02607 (WO '607).

Applicants respectfully traverse each of the rejections.

At page 3 of the Office Action, the Examiner's obviousness analysis begins by noting that the claims are in the product-by-process format, and based on this, the Examiner finds that the claims are not patentable over the prior art, since patentability is based on the product itself and the patentability of a product does not depend on its method of production.

Applicants respectfully submit that the Examiner's analysis of patentability for the inventive product-by-process claims should be taken one step further. MPEP 2113 states:

[t]he structure implied by the process steps should be considered when assessing the patentability of product-by-process claims over the prior art, especially where the ... manufacturing process steps would be expected to impart distinctive structural characteristics to the final product. (Emphasis added).

Accordingly, the process steps in the product-by-process claims should be given patentable weight when the process steps would be expected to form a product having structural characteristics which are distinct from the structure of the prior art product.

Applicants respectfully submit that based on the following comments, it is clear that the step of mixing polyphenylene ether (a) with the modifier (b) at a reaction temperature of from room temperature to the melting point of (a) results in a product which is structurally distinct from the products of the cited prior art. In view of the fact that the inventive product is structurally distinct from the products of the prior art, the inventive process step should be given patentable weight.

Some of the relevant data from the present specification which shows that the inventive mixing step results in a structurally distinct product from the products of the prior art, are given in the following table for the Examiner's convenience:

		Ex. 1	Ex. 12	Comp. Ex. 1	Comp. Ex. 2	Comp. Ex. 5	Comp. Ex. 6
Composition	(A) PPE-1	95	95				
	PPE-4			95		95	
	PPE-5				95		95
	(B) LCP-1	5	5	5	5	5	5
	LCP-2						
	LCP-3						
	LCP-4						
	(C) Kind (amount phr)		ZnO (0.15)			ZnO (0.15)	ZnO (0.15)
	(D) GF						
	Impact resistance Dart (J/m)		54.4			8.6	6.4
	Ductile fracture		○			×	×
Physical properties	Color tone white-ness W (Lab)	59.3	61.1	50.4	48.6	51.2	50.3
	Less generation of black foreign matters	15	10	61	88	85	132
	Fluidity SSP (MPa)	5.2	5.5	5.7	5.5	7.2	6.9
	Heat DTUL resistance (°C)	185	184	182	182	182	182
	Flame Average Retardancy combustion time (sec)	7.4	7.8	8.5	13	11.3	17
	(UL)	V-1	V-1	V-1	V-1	V-1	V-1
	Bending properties	FM (GPa)	2.77	2.78	2.80	2.79	2.79
		FS (MPa)	114	111	121	123	118
	Tensile Properties	TM (GPa)	1.76	1.79	1.73	1.76	1.71
		TS (MPa)	78	76	74	74	71
							72

The nature of the present invention is that a novel functionalized PPE is provided, even when using the same raw materials, by employing a different functionalization process from the conventional ones. This is demonstrated by Example 1 and Comparative Example 2 of the present application, wherein the same raw materials were used. It is clear from the comparison of the data from these Examples as shown in the above table, that the composition using the functionalized PPE according to the present invention involves significant improvements as compared to the composition using the conventional PPE, in the aspects of extremely excellent color tone and less generation of black foreign matter.

Furthermore, as demonstrated by Example 12 in comparison with Comparative Example 6, the dart impact resistance is drastically improved in the case where a minute amount of metal element is present. This is a second favorable aspect of the present invention.

The key of the present invention resides in the process for obtaining the novel functionalized PPE. According to the process, PPE is allowed to react at a temperature not higher than the melting point of PPE, and hence the reaction proceeds in the solid state. On the contrary, all the references cited by the Examiner are directed to a melt-kneading method or a suspension method.

For the foregoing reasons, the present invention is novel and unobvious over the disclosure of the cited references.

A further detailed explanation is given below in regard to the functionalization of the polymer of the present invention that is largely different from the conventional one disclosed in the cited references.

The functionalized PPE used in the present invention is obtained through the reaction of PPE and a modifier. The temperature of the reaction is important and peculiar to the present invention. In the present invention, the reaction temperature is regulated as being "from room temperature to the melting point of PPE". On the other hand, conventionally known functionalization processes are roughly divided into melt-kneading methods and solution methods.

Firstly, in the melt-kneading method, a modifier and PPE are allowed to react with each other by heating the system to a temperature higher than the melting point of PPE. On the contrary, according to the present invention, the reaction is carried out at a temperature not higher than the melting point of PPE. Therefore, PPE powder is functionalized with the modifier while maintaining its solid state without melting (hereinafter sometime referred to as "solid functionalization"). The solid functionalization as employed in the present invention is distinct from the conventional melt-kneading method in this regard.

Secondly, the conventional solution method uses a large amount of solvent, which necessitates a solvent-removal step, and hence

involves an increased cost in the aspects of equipment and energy. On the contrary, the present invention is directed to a technique of completing the functionalization reaction with a modifier while maintaining the solid state of PPE powder. The solid functionalization in the present invention is largely distinct from the conventional solution method in this regard.

We now turn to the individual references.

Furuta '254 teaches a functionalization process as being "melt-kneading reaction or suspension reaction" (col. 5, lines 2-3). The Examples are directed to a melt-kneading method (col. 13, line 40) or a suspension method (col. 13, line 62). Thus, the method disclosed in Furuta '254 is clearly distinct from the solid functionalization as employed in the present invention.

Jalbert et al. indicate its process is to obtain a functionalized PPE by "melt-mixing" in claim 1 and does not disclose the solid process.

Van der Meer et al. indicate its functionalization process as being "melt-mixing" in claim 1 and does not disclose the solid process.

Furuta '689 indicates its functionalization process as being "melt-kneading" in claim 3 (col. 18, line 58) and the description (col. 4, line 45 and col. 5, lines 47-51), thus being distinct from the solid functionalization as employed in the present invention.

WO '607 discloses the morphology of its composition, in which the diameter of the dispersed phase is described, but there is no description concerning the diameter of the powder functionalized PPE, *per se*. In addition, this reference provides nothing concerning a functionalized PPE obtained by a solid reaction.

As the MPEP directs, all the claim limitations must be taught or suggested by the prior art to establish a *prima facie* case of obviousness. See MPEP § 2143.03. Applicants respectfully submit that the inventive claims are patentable over the cited prior art, since the cited prior art fails to teach or fairly suggest the inventive product which is structurally distinct from the products of the cited prior art in view of the inventive step of mixing polyphenylene ether (a) with the modifier (b) at a reaction temperature of from room temperature to the melting point of (a). As such, withdrawal of the rejection is respectfully requested.

Applicants respectfully submit that even assuming *arguendo*, that the inventive claims are *prima facie* obvious over the cited prior art, the experimental evidence of unexpected results overcomes the *prima facie* finding.

We now turn to the evidence of unexpected results of the present invention.

As described above, one feature of the present invention resides in that PPE is subjected to functionalization reaction with

a modifier at a temperature from room temperature to the melting point of PPE (solid functionalization). When the solid functionalized PPE thus obtained is blended with the liquid crystal polymer (LCP) within a specific ratio range, the resulting resin composition surprisingly has less number of black foreign matter. This effect is not taught by any of the cited references and also cannot be expected from the disclosure thereof, and is highly worthy industrially. More specifically, it can be seen from the results of the entry described as "less generation of black foreign matter" in the table given above that the compositions of Comparative Example 1 (using unfunctionalized PPE) and Comparative Example 2 (using PPE functionalized by melt-kneading) had black foreign matter as large in number as 61 and 88, respectively, whereas the composition of Example 1 (using solid-functionalized PPE) has only 15. In addition to that, the composition of the present invention is also excellent in color tone and achieves a high level of fluidity, heat resistance, flame retardancy and mechanical properties at the same time, such being largely distinct from the conventional ones.

Furthermore, Jalbert et al. and van der Meer et al. are mostly directed to a blend of PPE and PA and neither of them disclose the use of LCP. On the other hand, Furuta '254, Furuta '256 and WO '607 do not disclose less generation of foreign matter and dart impact resistance, even though they mention LCP.

As yet another aspect of the present invention, when using a compound containing a polyvalent metal element (i.e., component (C)) in combination with the solid-functionalized PPE, an extremely high effect in dirt impact resistance is surprisingly obtained. More specifically, it can be seen from the results of "impact resistance (dart)" shown in the above table that Comparative Example 5 (using unfunctionalized PPE) and Comparative Example 6 (using PPE functionalized by melt-kneading) resulted in brittle fracture, whereas Example 12 (using solid-functionalized PPE) resulted in ductile fracture. Thus, the use of the solid-functionalized PPE gives a surprising effect with respect to the impact resistance. By the addition of a small amount of a compound containing a polyvalent metal element, the impact resistance of the composition comprising the solid-functionalized PPE and LCP is drastically improved. This effect is unexpected from the disclosure of the cited references.

In summary, the invention of claim 1 employing the above-described specific component realizes a satisfactory level of color tone, moldability, heat resistance, flame retardancy and mechanical properties at the same time and gives particularly excellent color tone and extremely less number of foreign matter. For the foregoing reasons, it is believed that the present invention is novel and unobvious over the disclosure of the cited prior art

references, and withdrawal of each of the rejections is respectfully requested.

CONCLUSION

In view of the above amendments and comments, Applicants respectfully submit that the claims are in condition for allowance. A notice to such effect is earnestly solicited.

Pursuant to the provisions of 37 C.F.R. §§ 1.17 and 1.136(a), the Applicants hereby petition for an extension of one (1) month to May 23, 2004 (a Sunday), in which to file a reply to the Office Action. The required fee of \$110.00 is attached hereto.

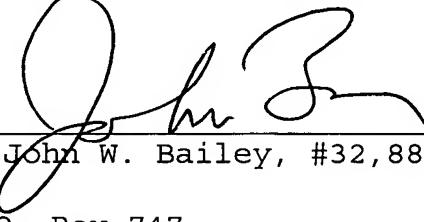
Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact **Garth M. Dahlen, Ph.D., Esq.** (Reg. No. 43,575) at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

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